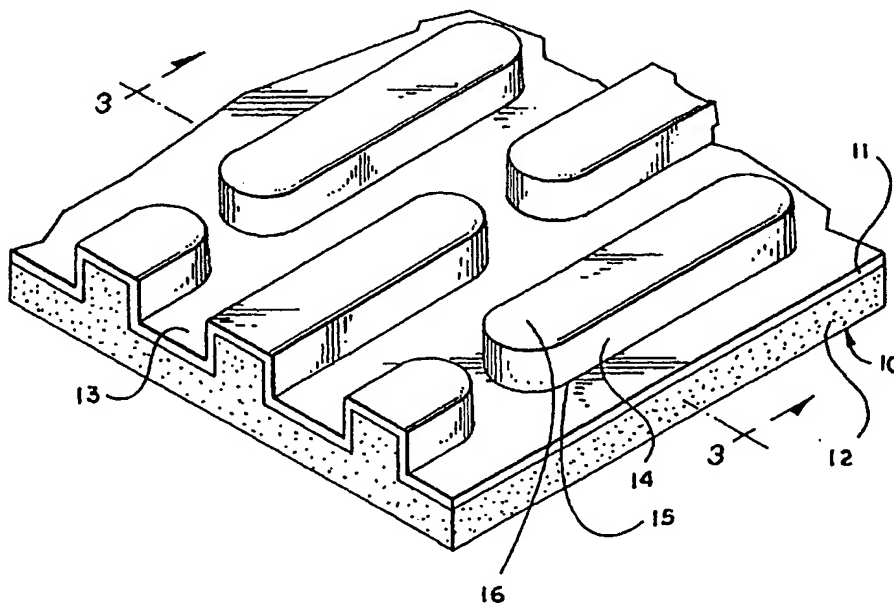




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(54) Title: TRACK CONTROL FLOOR MATS AND APPLICATIONS THEREFOR



(57) Abstract

The present invention is directed to track control mats (10). The track control mats (10) contain two distinct, superimposed, layers of polymeric material. The first layer (12), or base layer, is formed from a first polymeric material, which provides a first degree of flexibility to the mat (10). The second layer (11), or cap layer, is formed from a second polymeric material, which may contain a colorant. The colorant enables the layers to be visually distinguishable from one another.

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TRACK CONTROL FLOOR MATS AND APPLICATIONS THEREFOR

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Technical Field

The present invention relates to track control mats and methods of making the same.

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Background of the Invention

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Rubber floor mats have emerged as the floor mat of choice in most industrial applications due to their durability, weather resistance, flexibility, abrasion resistance, skid (slip) resistance, reasonable cost, and ease of manufacture. As rubber mats have gained acceptance and greater utility, the need for colored rubber mats, as opposed to standard black rubber mats, has gained much interest. However, cost and processability of colored rubber mats have slowed improvements in this area.

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Early attempts to color black rubber mats involved mechanically altering (i.e., abrading) a surface of a rubber mat followed by painting the surface. This process involved numerous steps including: abrading a surface of a rubber mat; applying an adhesive tie layer to the abraded surface of the mat; and applying a latex material containing a colorant to the adhesive tie layer. This process involved considerable cost and resulted in a colored rubber mat; however, the latex-containing layer had no elastic properties and had a tendency to peel. More recent attempts to produce colored rubber composites are disclosed in U.S. Patent No. 3,669,828 issued to Usamoto et al. (hereafter, "Usamoto").

Usamoto discloses a process of making colored ethylene-propylene rubber laminates. The laminates are prepared by

forming a first vulcanized rubber sheet containing a colorant, and a second semi-vulcanized rubber sheet. The two sheets are joined together and further vulcanized to obtain a colored rubber composite. While Usamoto discloses colored ethylene-propylene rubber laminates having a colored layer therein, Usamoto fails to teach colored rubber mats, wherein the portion of colored rubber within the mat is minimized in order to minimize cost of production. Further, Usomoto, fails to teach complex shapes or cleats formed on an upper and/or lower surface of the rubber mats.

What is needed in the art is a low-cost method of making colored rubber mats having the desirable features of black rubber mats, as well as, an aesthetically pleasing and/or functional colored layer on an upper surface of the rubber mats.

Summary of the Invention

The present invention relates to rubber composite mats comprising two distinct, superimposed, layers of polymeric material. The first layer, or base layer, comprises a first polymeric material, which provides a first degree of rigidity to the mat, as well as, other properties, including a planar slip-resistant outer surface. The second layer, or cap layer, comprises a second polymeric material, which may contain a colorant. The colorant enables the layers to be visually distinguishable from one another.

The present invention is also directed to methods of making the above-described composite mat.

These and other features and advantages of the present invention will become apparent after a review of the following detailed description of the disclosed embodiments and the appended claims.

Brief Description of the Figures

Figure 1 depicts a mat of the present invention.

Figure 2 depicts a vertical cross-section of the mat of the present invention.

Detailed Description of the Invention

The invention relates to rubber composite mats comprising two distinct, superimposed, layers of polymeric material. The first layer, or base layer, comprises a first
5 polymeric material, which provides a first degree of rigidity to the mat and other properties, including a planar slip-resistant outer surface. The second layer, or cap layer, comprises a second polymeric material, which provides a second degree of rigidity to the mat. The second layer may contain a colorant,
10 which enables the layers to be visually distinguishable when viewed in cross-section.

Referring to the drawings, a composite rubber mat of the present invention is shown in Figure 1. The composite mat 10
15 comprises a first layer, or base layer, 12 formed from a first polymeric material, and a second layer, or cap layer, 11 formed from a second polymeric material, which may include a colorant. The composite mat 10 has an upper surface 13 and a plurality of cleats 14 extending outwardly from outer surface
20 13.

The composite rubber mat of the present invention comprises base layer 12, which comes into contact with a floor. The base layer comprises one or more heat-curable elastomeric or thermoplastic materials. Heat-curable elastomeric materials
25 include, but are not limited to, vulcanizable elastomers, which are cured by a sulfur reaction mechanism or a metallic oxide mechanism. Suitable elastomeric materials include, but are not limited to, rubber such as natural rubber; butadiene polymers and copolymers such as styrene-butadiene rubbers and polybutadiene rubbers; isoprene polymers and copolymers;
30 chloroprene rubbers such as neoprene; nitrile rubbers; butyl rubbers; ethylene-propylene rubbers; and blends thereof. Desirably, the elastomeric material of base layer 12 is a nitrile rubber. Suitable thermoplastic materials include, but are not limited to, polyvinyl chloride, polyethylene, ethylene-vinyl
35 acetate, polypropylene, and thermoplastic rubber.

In addition to the one or more elastomeric materials, one or more materials may be added to the base layer composition. Suitable additives include, but are not limited to, inorganic

5 fillers, lubricants, antioxidants, plasticizers, curing agents, cross-linking agents, activators, UV inhibitors, antiozonants, and accelerators (primary and secondary accelerators). The inorganic filler may be a natural or synthetic, organic or inorganic filler. Suitable inorganic fillers include, but are not limited to, calcium carbonates, clays, talcs, carbon black, silica, silicates and oxides of titanium, zinc, and aluminum. Suitable organic fillers include, but are not limited to, fibers such as cotton, rayon, nylon, and other polymeric fibers. The amount of filler may vary as desired by one of ordinary skill in the art. In one embodiment of the present invention, the filler is added to the base layer composition in an amount ranging from about zero to 200 parts per weight of filler per 100 parts per weight of elastomeric/thermoplastic material.

15 Cross-linking agents useful in the present invention include, but are not limited to, organic peroxides, oxime compounds, sulfur, or a blend thereof. Suitable organic peroxides include, but are not limited to, dicumyl peroxide and 2,5-dimethyl-2,5-di(*tert*-butylperoxy)hexylene. Suitable oxime compounds include, but are not limited to, *p*-quinonedioxime and *p,p'*-benzoylquinonedioxime. Other suitable cross-linking agents include, but are not limited to, tetramethyl thiuram tetrasulfide, selenium diethyl dithiocarbamate, tetramethyl thiuram disulfide, and tetraethyl thiuram tetrasulfide. The amount of cross-linking agent may vary as desired by one of ordinary skill in the art. Desirably, the cross-linking agent is added to the base layer composition in an amount ranging from about zero to 5 parts per weight of cross-linking agent per 100 parts per weight of elastomeric/thermoplastic material. More desirably, the cross-linking agent is added to the base layer composition in an amount ranging from about 1 to 2 parts per weight of cross-linking agent per 100 parts per weight of elastomeric/thermoplastic material.

35 In addition to the cross-linking agents above, one or more activators may be added to the base layer composition. Suitable activators include, but are not limited to, zinc oxide and stearic acid. Desirably, the activator is added to the base layer composition in an amount ranging from about zero to 5

parts per weight of activator per 100 parts per weight of elastomeric/thermoplastic material. More desirably, the activator is added to the base layer composition in an amount ranging from about 1 to 4 parts per weight of activator per 100 parts per weight of elastomeric/thermoplastic material.

Accelerators useful in the present invention include, but are not limited to, primary accelerators, secondary accelerators, or a blend thereof. As used herein the term "primary accelerator" refers to an accelerator, which enables and/or enhances the initiation of the curing and/or cross-linking process. As used herein the term "secondary accelerator" refers to an accelerator, which helps control the rate of cure and/or cross-linking. Suitable accelerators include, but are not limited to, mercaptobenzothiazoles and salts thereof, benzothiazyl disulfide, activated dithiocarbamates such as SETSIT®-5 and SETSIT®-9, zinc dimethyldithiocarbamate, zinc diethyldithiocarbamate, zinc dibutyldithiocarbamate, tetramethylthiuram disulfide (TMTD), tetraethylthiuram disulfide (TETD), tetramethylthiuram monosulfide (TMTM), and DELAC® S (available from SANTOCURE). The amount of accelerator may vary as desired by one of ordinary skill in the art. Desirably, the accelerator is added to the base layer composition in an amount ranging from about zero to 5 parts per weight of accelerator per 100 parts per weight of elastomeric/thermoplastic material. More desirably, the accelerator is added to the base layer composition in an amount ranging from about 0.1 to about 3 parts per weight of accelerator per 100 parts per weight of elastomeric/thermoplastic material. Most desirably, the accelerator is added to the base layer composition in an amount ranging from about 0.1 to about 1.5 parts per weight of accelerator per 100 parts per weight of elastomeric/thermoplastic material.

Any antioxidant known to those of ordinary skill in the art may be used in the present invention. Suitable antioxidants include, but are not limited to, hydroquinone mono benzyl ether, phenyl-beta naphthylamine, polymerized trimethyl

5 dihydroquinolines such as AGERITE® RESIN D, octylated
diphenylamines such as AGERITE® STALITE, styrenated
phenol such as AGERITE® SPAR, di-beta-naphthyl-para-
phenylenediamine, and OCTAMINE®. The amount of
antioxidant may vary as desired by one of ordinary skill in the
art. Desirably, the antioxidant is added to the base layer
composition in an amount ranging from about zero to 2 parts
per weight of accelerator per 100 parts per weight of
10 elastomeric/thermoplastic material. More desirably, the
antioxidant is added to the base layer composition in an
amount ranging from about 1 to 2 parts per weight antioxidant
per 100 parts per weight of elastomeric/thermoplastic material.

In addition to antioxidants, one or more antiozonants
may be added to the base layer composition. Any antiozonant
15 known to those of ordinary skill in the art may be used in the
present invention. Suitable antiozonants include, but are not
limited to, paraffin waxes, microcrystalline waxes, Carnuaba
wax, and hydrocarbon waxes, such as SUNPROOF® Jr. The
amount of antiozonant may vary as desired by one of ordinary
20 skill in the art. Desirably, the antiozonant is added to the base
layer composition in an amount ranging from about zero to 2
parts per weight of antiozonant per 100 parts per weight of
elastomeric/thermoplastic material. More desirably, the
antiozonant is added to the base layer composition in an
25 amount ranging from about 1 to 2 parts per weight
antiozonant per 100 parts per weight of
elastomeric/thermoplastic material.

One or more plasticizers may also be added to the base
layer composition. Any plasticizer known to those of ordinary
30 skill in the art may be used in the present invention. Suitable
plasticizers include, but are not limited to, diisononyl phthalate
(DINP), di-2-ethylhexyl phthalate (DOP), and SUNDEX® 8125,
an aromatic oil available from Sun Oil Company, Inc.,
Philadelphia, PA. The amount of plasticizer may vary as
35 desired by one of ordinary skill in the art. Desirably, the
plasticizer is added to the base layer composition in an amount
ranging from about zero to 50 parts per weight of plasticizer
per 100 parts per weight of elastomeric/thermoplastic material.

More desirably, the plasticizer is added to the base layer composition in an amount ranging from about 10 to 25 parts per weight plasticizer per 100 parts per weight of elastomeric/thermoplastic material.

5 The composite rubber mats of the present invention further comprise cap layer 11. Cap layer 11 also comprises one or more of the above-described elastomeric materials. Like base layer 12, cap layer 11 may contain one or more of the above-described materials in addition to the elastomeric material. In addition to the one or more elastomeric materials, 10 cap layer 11 may contain a colorant. The colorant may comprise an organic dye, a pigment, or a combination thereof. Suitable dyes and pigments include, but are not limited to, triarylmethyl dyes, such as Malachite Green Carbinol base {4-(dimethylamino)-[4-(dimethylamino)phenyl]-phenyl- 15 benzene-methanol}, Malachite Green Carbinol hydrochloride {N-4-[[4-(dimethylamino)phenyl]phenyl-methylene]-2,5-cyclohexyldien-1-ylidene]-N-methyl-methanaminium chloride or bis[p-(dimethylamino)phenyl]phenylmethylium chloride}, and Malachite Green oxalate {N-4-[[4-(dimethylamino)-phenyl]- 20 phenylmethylene]-2,5-cyclohexyldien-1-ylidene]-N-methyl-methanaminium chloride or bis[p-(dimethylamino)-phenyl]phenylmethylium oxalate}; monoazo dyes, such as Cyanine Black, Chrysoidine [Basic Orange 2; 4-(phenylazo)-1,3-benzenediamine monohydrochloride], Victoria Pure Blue BO, 25 Victoria Pure Blue B, basic fuschin and β -Naphthol Orange; thiazine dyes, such as Methylene Green, zinc chloride double salt [3,7-bis(dimethylamino)-6-nitrophenothiazin-5-ium chloride, zinc chloride double salt]; oxazine dyes, such as Lumichrome (7,8-dimethylalloxazine); naphthalimide dyes, such as Lucifer Yellow CH {6-amino-2-[(hydrazino-carbonyl)amino]-2,3-dihydro-1,3-dioxo-1H-benz[de]iso-quinoline-5,8-disulfonic acid dilithium salt}; azine dyes, such as Janus Green B {3-(diethylamino)-7-[[4-(dimethyl-amino)phenyl]azo]-5- 30 phenylphenazinium chloride}; cyanine dyes, such as Indocyanine Green {Cardio-Green or Fox Green; 2-[7-[1,3-dihydro-1,1-dimethyl-3-(4-sulfobutyl)-2H-benz[e]indol-2-ylidene]-1,3,5-heptatrienyl]-1,1-dimethyl-3-(4-sulfobutyl)-1H-

benz[e]indolium hydroxide inner salt sodium salt}; indigo dyes,
 such as Indigo {Indigo Blue or Vat Blue 1; 2-(1,3-dihydro-3-
 oxo-2H-indol-2-ylidene)-1,2-dihydro-3H-indol-3-one};
 coumarin dyes, such as 7-hydroxy-4-methyl-coumarin (4-
 5 methylumbelliferone); benzimidazole dyes, such as Hoechst
 33258 [bisbenzimidazole or 2-(4-hydroxyphenyl)-5-(4-methyl-1-
 piperazinyl)-2,5-bis-1H-benzimidazole trihydro-chloride
 pentahydrate]; paraquinoidal dyes, such as Hematoxylin
 {Natural Black 1; 7,11b-dihydrobenz[b]-indeno[1,2-d]pyran-
 10 3,4,6a,9,10(6H)-pentol}; fluorescein dyes, such as
 Fluoresceinamine (5-aminofluorescein); diazonium salt dyes,
 such as Diazo Red RC (Azoic Diazo No. 10 or Fast Red RC salt;
 2-methoxy-5-chlorobenzenediazonium chloride, zinc chloride
 double salt); azoic diazo dyes, such as Fast Blue BB salt (Azoic
 15 Diazo No. 20; 4-benzoylamino-2,5-diethoxy-benzene diazonium
 chloride, zinc chloride double salt); phenylenediamine dyes,
 such as Disperse Yellow 9 [N-(2,4-dinitrophenyl)-1,4-
 phenylenediamine or Solvent Orange 53]; diazo dyes, such as
 Disperse Orange 13 [Solvent Orange 52; 1-phenylazo-4-(4-
 20 hydroxyphenylazo)naphthalene]; anthra-quinone dyes, such as
 Disperse Blue 3 [Celliton Fast Blue FFR; 1-methylamino-4-(2-
 hydroxyethylamino)-9,10-anthraquinone], Disperse Blue 14
 [Celliton Fast Blue B; 1,4-bis(methylamino)-9,10-
 anthraquinone], and Alizarin Blue Black B (Mordant Black 13);
 25 trisazo dyes, such as Direct Blue 71 (Benzo Light Blue FFL or
 Sirius Light Blue BRR; 3-[(4-[(4-[(6-amino-1-hydroxy-3-sulfo-2-
 naphthalenyl)azo]-6-sulfo-1-naphthalenyl)-azo]-1-naphtha-
 lenyl)azo]-1,5-naphthalenedisulfonic acid tetrasodium salt};
 xanthene dyes, such as 2,7-dichloro-fluorescein; proflavine
 30 dyes, such as 3,6-diaminoacridine hemisulfate (Proflavine);
 sulfonaphthalein dyes, such as Cresol Red (o-
 cresolsulfonaphthalein); phthalocyanine dyes, such as Copper
 Phthalocyanine {Pigment Blue 15; (SP-4-1)-[29H,31H-
 phthalocyanato(2-)-N²⁹,N³⁰,N³¹,N³²]copper}, phthalocyanine
 35 green, and phthalocyanine blue; carotenoid dyes, such as
 trans- β -carotene (Food Orange 5); carminic acid dyes, such as
 Carmine, the aluminum or calcium-aluminum lake of carminic
 acid (7-a-D-glucopyranosyl-9,10-dihydro-3,5,6,8-tetrahydroxy-

1-methyl-9,10-dioxo-2-anthracene-carboxylic acid); azure dyes, such as Azure A [3-amino-7-(dimethylamino)phenothiazin-5-ium chloride or 7-(dimethyl-amino)-3-imino-3H-phenothiazine hydrochloride]; and acridine dyes, such as Acridine Orange [Basic Orange 14; 3,8-bis(dimethylamino)acridine hydrochloride, zinc chloride double salt] and Acriflavine (Acriflavine neutral; 3,6-diamino-10-methylacridinium chloride mixture with 3,6-acridine-diamine); calcatones; Latex orange RRTD; Latex pink FFD; Latex scarlet 2GHN; Latex violet 6RD; and Latex yellow GCD.

The amount of dye and/or pigment in the cap layer composition may vary greatly. Desirably, the amount of colorant added to cap layer composition is from about 1 to about 30 parts per weight of colorant per 100 parts per weight of elastomeric material. More desirably, the colorant is added to the cap layer composition in an amount ranging from about 1 to about 20 parts per weight colorant per 100 parts per weight of elastomeric material. Most desirably, the colorant is added to the cap layer composition in an amount ranging from about 1 to about 3 parts per weight colorant per 100 parts per weight of elastomeric material. Desirably, cap layer 11 has a color, which is visually distinguishable from base layer 12. Cap layer 11 may be any color including, but not limited to, red, yellow, green, and blue. In one embodiment of the present invention, at least a portion of cap layer 11 contains a bright yellow colorant. In this embodiment, the resulting composite mat functions as a floor mat and also provides safety slogans to a user.

The composite rubber mat of the present invention further comprises a plurality of cleats, or projections, 14 on at least one outer surface of the composite rubber mat. The shape, size, and density of cleats 14 may vary depending upon the intended use of the composite mat. As used herein, the term "density" refers to the number of cleats per unit area of composite mat surface. Cleats 14 may have a sidewall 15 and an upper surface 16 as shown in Figure 1. Sidewall 15 may extend from and form an angle α with outer surface 13. Angle α may be from about 45 degrees to about 165 degrees.

Desirably, the angle formed between sidewall 15 and outer surface 13 is in the range of about 90 degrees to about 135 degrees. More desirably, the angle between sidewall 15 and outer surface 13 is from about 90 degrees to about 110 degrees. The surface area of the upper surface 16 may vary from less than about 5% to about 90% of the total surface area, wherein the total surface area includes the surface area of upper surface 16 and the surface area of outer surface 13. Desirably, the surface area of the upper surface 16 varies from about 25% to about 80% of the total surface area.

Upper surface 16 of cleat 14 may have a variety of geometric shapes. Suitable geometric shapes for upper surface 16 include, but are not limited to, a point, a line, a triangle, a square, a rectangle, a circle, an obround, a hexagon, a star, a cloverleaf, a diamond, and a parallelogram. As with the size and shape of cleats 14, the height of cleats 14 may vary greatly depending upon the intended use of the composite mat. As used herein, the term "height" refers to the distance between outer surface 13 and upper surface 16. Desirably, cleats 14 may have a height of up to about 1/2-inch (12.7 mm). More desirably, the cleats have a height of about 1/16 inch (1.5 mm) to about 1/4 inch (6.4 mm). Most desirably, the cleats have a height of about 1/8 inch (3.2 mm). Even though all cleats 14 have substantially the same height as shown in Figure 1, it should be understood that cleats 14 may have a variety of heights, sizes, shapes, and densities on a given composite rubber mat.

As discussed above, the number and size of cleats per unit surface area of composite rubber mat may vary as determined by one of ordinary skill in the art. Needless to say, as cleats 14 become smaller in size, the number of cleats per unit area may increase. In one embodiment of the present invention, the surface area of upper surface 16 occupied by cleats 14 is equal to about 20% to about 80% of the total outer surface area of the composite mat.

Figure 2 depicts a vertical cross-section of the composite mat of the present invention. Composite rubber mat 10 comprises base layer 12 and cap layer 13 joined at an interface

21. Base layer 12 comprises an outer slip-resistant surface 22 for placement stability on floors, such as a concrete, wood, tile, linoleum, marble, carpet, stone, or ceramic floor. Cap layer 11 is integrally bonded to base layer 12, and together with a portion of base layer material 23, form a plurality of cleats 14. Although base layer 12 and cap layer 11 may have substantially the same thickness, desirably the thickness of base layer 12 contributes substantially to the overall thickness of the composite mat. In order to minimize cost of manufacturing, it is desirable to minimize the thickness of cap layer 11. In one embodiment of the present invention, base layer 12 has a thickness in the range of from about 1 to about 25 millimeters, while cap layer 11 has a thickness of up to about 5 millimeters. Desirably, base layer 12 has a thickness in the range of from about 1 to about 10 millimeters and cap layer 11 has a thickness of about 0.5 to 2 millimeter. More desirably, base layer 12 has a thickness in the range of from about 1.5 to about 5 millimeters and cap layer 11 has a thickness of about 0.5 to 1 millimeter.

As shown in Figure 2, cap layer 11 may be a continuous layer integrally attached to base layer 12. However, it should be noted that cap layer 11 may be a continuous or discontinuous layer. In one embodiment of the present invention, cap layer 11 is a single discontinuous layer, which covers only a portion of base layer 12. In a further embodiment of the present invention, cap layer 11 comprises more than one discontinuous layer portion, wherein the layer portions are substantially within the same plane. In other words, two or more discontinuous layer portions, which may be in a juxtaposition relationship with one another, form cap layer 11. In yet a further embodiment of the present invention, one or more cap layer portions are positioned in an overlapping manner such that at least a portion of cap layer 11 comprises multiple layers. One example of such a composite mat comprises a continuous base layer, a continuous intermediate cap layer portion, and an upper cap layer portion in the form of a label with a company name or logo.

Desirably, the thickness (gauge) of cap layer 11 is uniform throughout the cap layer. However, the manufacturing process as described below may inherently produce some variation in cap layer 11 thickness from upper surface 16 to sidewall 15 to outer surface 13. Although it is desirable for the thickness of cap layer 11 to remain substantially the same throughout the layer, the thickness of cap layer 11 may be intentionally varied from one portion of the composite mat to another.

As shown in Figure 2, the composite mat of the present invention may comprise a plurality of cleats on an upper surface of the mat, wherein each cleat is formed from base layer 12 and cap layer 11. Desirably, base layer 12 and cap layer 11 are substantially free of voids. Care should be taken during the manufacturing process to eliminate potential voids within the cleats. Although cleats are only shown on an outer surface 13 of the composite mat in Figure 2, it should be understood that cleats may also be present on the lower surface 22 of the mat. Cleats on the lower surface 22 of the mat may be substantially the same size, shape, and density as described above. Desirably, cleats on the lower surface 22 of the composite mat are smaller and present at a higher density than cleats on the outer surface 13. In one embodiment of the present invention, cleats on a lower surface of the composite mat have a height of up to about 1/16 inch (1.5 mm). More desirably, the cleats on a lower surface of the composite mat have a height of about 1/64 inch (0.4 mm) to about 1/32 inch (0.8 mm).

The composite mat of the present invention may also contain other structural features, such as an edge or border, as well as, perforations throughout the mat. In one embodiment of the present invention, the composite mat comprises a border along a periphery of the mat, wherein the border has a thickness substantially equal to the combined thickness of the base layer 12 and the cap layer 11. Desirably, the border thickness gradually decreases along the border width, such that an inner portion of the border is thicker than the outer periphery of the border and mat. The border width may vary

as desired by one of ordinary skill in the art. Desirably, the border width is from about 1/2 inch (12.7 mm) to about 5 inches (127 mm) in length. More desirably, the border width is from about 1 inch (25.4 mm) to about 3 inches (76.2 mm) in length.

The composite mat of the present invention may be produced in a variety of sizes. The choice of mat dimensions (length and width) is not limited in any way, although manufacturing considerations and customer needs usually determine typical mat dimensions. In one embodiment of the present invention, composite mats have a length of up to about 130 inches (3302 mm) and a width of up to about 82 inches (2083 mm). In a further embodiment, the composite mats of the present invention have a length of up to about 82 inches (2083 mm) and a width of up to about 58 inches (1473 mm). In yet a further embodiment, the composite mats of the present invention have a length of up to about 52 inches (1321 mm) and a width of up to about 40 inches (1016 mm).

The present invention is also directed to methods of making the above-described mat. The base layer sheet and cap layer sheet may be formed from separate processes, such as a calendering process, and subsequently joined, prior to curing, to form a composite sheet. Alternatively, the base layer sheet and cap layer sheet may be formed in a continuous process, wherein the base layer sheet is formed and the cap layer sheet is formed on top of the base layer sheet. The composite sheet may be continuously processed through a pressure roll to integrally attach the base layer sheet and cap layer sheet to one another. The resulting composite sheet may be stored for a period of time or immediately formed into a composite mat.

The base layer or cap layer components are combined in a vessel and mixed to uniformly distribute the components throughout the mixture. Desirably, the components are subjected to dynamic mixing in a mixer, such as a Banbury mixer. Some components, such as cross-linking agents and activators, may be added to the mixture immediately prior to further processing operations. Desirably, a latex is formed

from one or more of the above-described components, mixed thoroughly, and processed within 48 hours of mixing. More desirably, the components are processed within 24 hours after mixing. The mixture may then be shaped to form a sheet.

5 In one embodiment of the present invention, base layer sheet and cap layer sheet are formed separately into two sheets having a desired thickness. Desirably, the base layer sheet has a thickness of from about 1 to about 40 millimeters prior to molding, while the cap layer sheet has a thickness of
10 up to about 8 millimeters prior to molding. More desirably, the base layer sheet has a thickness in the range of from about 1 to about 16 millimeters and the cap layer sheet has a thickness of about 0.5 to 4 millimeter prior to molding. Most desirably, the base layer sheet has a thickness in the range of from about 2 to
15 about 8 millimeters and the cap layer sheet has a thickness of about 0.5 to 1.5 millimeter prior to molding.

In one embodiment of the present invention, the base sheet layer and cap sheet layer are formed in a continuous or separate calendering process. Calendering process parameters
20 may vary as desired by one of ordinary skill in the art. Desirably, the calender roll speed is from about 25 to about 100 ft/min, and the calender roll temperature is from about 90°F to about 140°F. More desirably, the calender roll speed is from about 40 to about 60 ft/min, and the calender roll temperature
25 is from about 100°F to about 120°F.

The base layer sheet and cap layer sheet are placed in intimate contact with one another and integrally bonded by a process, such as a calendering process, to remove any air present at the laminate interface. The resulting laminate is
30 press-molded and shaped to form a composite mat. Desirably, a perforated metal sheet is pressed onto the outer and/or lower surface(s) of the composite sheet to form a plurality of cleats on one or both surfaces. Suitable perforated metal sheets include, but are not limited to, perforated metal sheets
35 available from McNichols Company, Tampa, Florida See McNICHOLS® "Perforated & Expanded Catalog 98", ©1998, which is herein incorporated in its entirety. The composite

sheet may be shaped and cured to a desired level during the press-molding step.

In a further embodiment of the present invention, base layer sheet 12 is formed into a sheet having a desired thickness. Cap layer 11 is also formed into a separate sheet having a desired thickness. In this embodiment, the cap layer, or a portion thereof, is at least partially cured prior to forming a composite sheet. Parameters for partial curing may vary as desired by one of ordinary skill in the art. In one embodiment of the present invention, the cap layer or cap layer portion is partially cured at a temperature of about 200°F to about 275°F for about 15 minutes to about 6 hours. In a further embodiment of the present invention, the cap layer or cap layer portion is partially cured at a temperature of about 240°F to about 260°F for about 30 minutes to about 4 hours. The base layer sheet and partially-cured cap layer sheet may be subsequently processed to form a composite sheet free from air at the laminate interface. The composite sheet may be subsequently shaped and cured in a molding step as described above. In this embodiment, partial curing or complete curing of the cap layer sheet imparts integrity to the cap layer sheet, which minimizes the formation of thin spots within the cap layer sheet during molding. Partial curing of cap layer 11 also minimizes the formation of undesirable "rubber flash" during plastic flow in three-dimensional molds. As used herein, the term "rubber flash" refers to rubber flow, which results in undesirable mold marks and/or feather edges. Partial or complete curing of cap layer sheet may be accomplished by any means known to those of ordinary skill in the art including, but not limited to, convection, conduction or radiant heat. Desirably, cap layer sheet is partially cured by heating in a forced convection hot air oven.

In yet a further embodiment of the present invention, the cap layer sheet 11 may be formulated to cure at a faster rate and with a shorter plastic flow time than the base layer sheet 12. One method of increasing the cure rate of the cap layer composition is to add one or more secondary accelerators to the composition, in addition to any primary accelerators

present. Cap layer sheet 11 may then be intimately joined to base layer sheet 12 and subsequently molded to form a composite mat. During the curing process, the cap layer sheet reaches and maintains a degree of integrity such that plastic flow time is reduced.

The composite sheet may be stored for a period of time prior to the shaping/curing step. Desirably, the composite sheet is stored for less than 24 hours prior to shaping and curing. However, composite sheets may be stored for a longer period of time, preferably in a cold room. The shaping and curing step may be performed by any method known in the art. Desirably, a bladder press-mold is used to shape and cure the composite sheet. Shaping and curing parameters may vary as desired by one of ordinary skill in the art. Desirably, the molding temperature is from about 250°F to about 350°F; the molding pressure is from about 15 to about 60 psi; and the molding time is from about 10 to 30 minutes. More desirably, the molding temperature is from about 275°F to about 325°F; the molding pressure is from about 30 to about 50 psi; and the molding time is from about 10 to 20 minutes.

Following the shaping/curing step, the composite mat of the present invention may be trimmed along the periphery of the mat to form a border as described above. Further, the composite mat of the present invention may be subjected to further processing as desired. In one embodiment of the present invention, the composite mat is perforated with holes throughout the mat. The hole size may vary as desired by one of ordinary skill in the art. Desirably, the hole size allows for water drainage through the cap later and base layer.

The present invention is further described by the examples which follow. Such examples, however, are not to be construed as limiting in any way either the spirit or the scope of the present invention. In the examples, all chemical components are given in parts by weight, unless stated otherwise.

EXAMPLE 1

A base layer composition was compounded and mixed with a Banbury mixer to form a first composition, designated 364-G-MB, using the following components:

Base Layer Component	PBW
CHEMIGUM™ X1 ¹	38.46
CHEMIGUM™ K ²	61.54
Carbon black N774 ³	69.93
Calcium carbonate ⁴	18.53
Zinc oxide ⁵	4.55
Stearic Acid Activator ⁶	0.91
Naugard Q ⁷	1.80
DINP ⁸	21.33

¹ CHEMIGUM™ X1 is a butadiene-acrylonitrile copolymer available from The Goodyear Tire & Rubber Company, Akron, Ohio.

² CHEMIGUM™ K is a butadiene-acrylonitrile copolymer available from The Goodyear Tire & Rubber Company, Akron, Ohio.

³ Carbon black N774 is available from Degussa Corporation, Ridgefield Park, NJ.

⁴ The calcium carbonate used is available from Franklin Industrial Minerals, Specialty Products Division, Dalton, GA.

⁵ The zinc oxide, identified as ZINOX 350, is used as an activator and is available from American Chemet Corporation, East Helena, MT.

⁶ The stearic acid, identified as INDUSTRENE®R, is used as an activator and is available from Witco Corporation, Humko Division, Memphis, TN.

⁷ Naugard Q is an antioxidant in the form of polymerized 2,2,4-trimethyl-1,2-dihydroquinoline, available from Alcan Rubber & Chemical, Inc., New York, NY.

⁸ DINP is a plasticizer in the form of diisononyl phthalate, available from Ashland Chemical Company, Columbus, OH.

The 364-G-MB composition was further mixed in a Barbury mixer with the following components to form a final base layer composition:

Base Layer Component	PBW
364-G-MB	216.78
DELAC® S ⁹	1.46
Sulfur ¹⁰	0.47
TMTD ¹¹	0.65
TMTM ¹²	0.09

⁹ DELAC® S, N-cyclohexyl-2-benzothiazole sulfenamide, is used as a secondary accelerator and is available from Uniroyal Chemical Company, Inc., Middlebury, CT.

¹⁰ The sulfur used was AKROCHEM® MC-98, available from Akrochem Corporation, Akron, OH.

¹¹ TMTD, tetramethylthiuram disulfide, is a primary accelerator, available from Flexsys America L.P., Akron, OH.

¹² TMTM, tetramethylthiuram monosulfide, is a secondary accelerator, available from Uniroyal Chemical Company, Inc., Middlebury, CT.

A cap layer composition was compounded and mixed in a Banbury mixer using the following components:

Cap Layer Component	PPW
BJLT-M50 ¹³	100.0
HiSil 233 ¹⁴	46.0
OCTAMINE® ¹⁵	1.00
SUNPROOF® Jr. ¹⁶	1.50
Zinc oxide	3.00
DINP ¹⁷	20.00
Sulfur	1.00
TMTD	1.30
Phthalocyanine Yellow	1.00

¹³ BJLT-M50 is a butadiene-acrylonitrile copolymer available from Uniroyal Chemical Company, Inc., Middlebury, CT.

¹⁴ HiSil 233 is an amorphous silica, available from PPG Industries, Inc., Pittsburgh, PA.

¹⁵ OCTAMINE® is an antioxidant in the form of an octylated diphenylamine, available from Uniroyal Chemical Company, Inc., Middlebury, CT.

¹⁶ SUNPROOF® Jr. is an antiozonant in the form of a blend of hydrocarbon waxes, available from Uniroyal Chemical Company, Inc., Middlebury, CT.

¹⁷ DINP, diisononyl phthalate, is a plasticizer, available from Ashland Chemical Company, Columbus, OH.

5 The final base layer composition was calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a base layer sheet having a thickness of about 2.8 mm. The cap layer composition was
10 separately calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a cap layer sheet having a thickness of about 1.4 mm. The two separate sheets were further calendered to form an integrally bonded composite sheet. The composite sheet was positioned
15 under a bladder press-mold. The sheet was press-molded with a McNICHOLS® Moire perforated metal sheet (1/8 inch x 3/4 inch round end slot 1/8 inch bars; 41% open area) at a temperature of 300°F, a pressure of about 40 psi, and a cure time of about 30 minutes, to form cleats on an outer surface of the composite sheet (the cap layer side of the composite sheet). The cleats contained a portion of the base layer and the cap layer. The resulting composite mat had an average base layer thickness of about 1.52 mm; an average cap layer thickness of about 0.94; and an average cleat height of about 3.12 mm.

20 EXAMPLE 2

A base layer sheet and cap layer sheet were formed using the compositions of Example 1. In this example, the final
25 base layer composition was calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a base layer sheet. The cap layer composition was separately calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a cap layer sheet. Then, the cap layer sheet was partially cured
30 by subjecting the cap layer sheet to a convection oven at a temperature of about 250°F for about 30 minutes. The two separate sheets were further calendered to form an integrally bonded composite sheet. The composite sheet was positioned under a bladder press-mold using the molding parameters of
35 Example 1 to form cleats on an outer surface of the composite sheet (the cap layer side of the composite sheet). The cleats contained a portion of the base layer and the cap layer. The resulting composite mat had an average base layer thickness of

about 2.09 mm; an average cap layer thickness of about 1.39; and an average cleat height of about 3.12 mm

EXAMPLE 3

A base layer sheet and cap layer sheet were formed using the compositions of Example 1, except that an additional component, MBTS, 2,2'-dithiobis(benzothiazole), was added to the cap layer composition as a secondary accelerator to accelerate the cure rate of the composition. The cap layer composition is given below:

Cap Layer Component	PPW
BJLT-M50	100.0
HiSil 233	46.0
OCTAMINE®	1.00
SUNPROOF® Jr.	1.50
Zinc oxide	3.00
DINP	20.00
Sulfur	1.00
MBTS ¹⁸	2.00
TMTD	1.30
Phthalocyanine Yellow	1.00

¹⁸ MBTS, 2,2'-dithiobis(benzothiazole), is a secondary accelerator, available as PERKACIT® MBTS from Flexsys America L.P., Akron, OH.

In this example, the final base layer composition was calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a base layer sheet having a thickness of about 2.8 mm. The cap layer composition was separately calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a cap layer sheet having a thickness of about 1.4 mm. The two separate sheets were further calendered to form an integrally bonded composite sheet. The composite sheet was positioned under a bladder press-mold. The sheet was press-molded with a McNICHOLS® Moire perforated metal sheet (1/8 inch x 3/4 inch round end slot 1/8 inch bars; 41% open area) at a

temperature of 300°F, a pressure of about 40 psi, and a cure time of about 15 minutes, to form cleats on an outer surface of the composite sheet (the cap layer side of the composite sheet). The cleats contained a portion of the base layer and the cap layer. The resulting composite mat had an average base layer thickness of about 1.48 mm; an average cap layer thickness of about 0.84; and an average cleat height of about 3.02 mm.

EXAMPLE 4

A base layer composition was compounded and mixed with a Banbury mixer to form a first composition, designated 364-G-MB2, using the following components:

Base Layer Component	PBW
CHEMIGUM™ X1	40.00
CHEMIGUM™ K	60.00
Carbon black N774	60.00
Calcium carbonate	15.00
Zinc oxide	4.00
Stearic Acid Activator	1.00
Naugard Q	2.00
DINP	22.00

The 364-G-MB2 composition was further mixed in a Banbury mixer with the following components to form a final base layer composition:

Base Layer Component	PBW
364-G-MB	204.00
DELAC® S	1.30
Sulfur	0.45
TMTD	0.60
TMTM	0.07

A cap layer composition was compounded and mixed in a Banbury mixer using the following components:

Cap Layer Component	PPW
BJLT-M50	100.0
HiSil 233	46.0
OCTAMINE®	1.00
SUNPROOF® Jr.	1.50
Zinc oxide	3.00
DINP	20.00
Sulfur	1.00
MBTS	2.00
TMTD	1.30
Phthalocyanine Blue	1.00

5

The final base layer composition was calendered at a calender line speed of about 40 ft/min. and a calender temperature of about 100°F to form a base layer sheet having a thickness of about 3.0 mm. The cap layer composition was separately calendered at a calender line speed of about 50 ft/min. and a calender temperature of about 110°F to form a cap layer sheet having a thickness of about 1.8 mm. The two separate sheets were further calendered to form an integrally bonded composite sheet. The composite sheet was positioned under a bladder press-mold. The sheet was press-molded with a McNICHOLS® Moire perforated metal sheet (1/8 inch x 3/4 inch round end slot 1/8 inch bars; 41% open area) at a temperature of 300°F, a pressure of about 40 psi, and a cure time of about 20 minutes, to form cleats on an outer surface of the composite sheet (the cap layer side of the composite sheet). The cleats contained a portion of the base layer and the cap layer. The resulting composite mat had an average base layer thickness of about 1.45 mm; an average cap layer thickness of about 1.20; and an average cleat height of about 3.00 mm.

25

While the specification has been described in detail with respect to specific embodiments thereof, it will be appreciated

5 that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

Claims

What is claimed is:

- 5 1. A composite mat comprising:
 a base layer having a lower surface and an upper
 surface and comprising a first polymeric material;
 a cap layer integrally attached to the upper surface
 of the base layer and having an outer surface and comprising a
10 second polymeric material; and
 a first plurality of cleats, wherein the first plurality
 of cleats comprise the first polymeric material of the base layer
 and the second polymeric material of the cap layer.
- 15 2. The composite mat of Claim 1, wherein the base
 layer and the cap layer comprise at least one elastomeric
 material selected from nitrile rubber, butadiene rubber,
 styrene-butadiene rubber, or a combination thereof.
- 20 3. The composite mat of Claim 2, wherein the cap
 layer further comprises a colorant.
- 25 4. The composite mat of Claim 3, wherein the base
 layer and the cap layer further comprise one or more
 additional components selected from inorganic fillers,
 lubricants, antioxidants, plasticizers, curing agents, cross-
 linking agents, activators, UV inhibitors, antiozonants,
 accelerators, and blends thereof.

5. The composite mat of Claim 4, wherein the base layer and the cap layer each comprise:
- 5 100 parts by weight nitrile rubber;
 0 to 200 parts by weight of filler material;
 0 to 5 parts by weight of a cross-linking agent;
 0 to 5 parts by weight of an activator;
 0 to 5 parts by weight of an accelerator;
10 0 to 2 parts by weight of an antioxidant;
 0 to 2 parts by weight of an antiozonant; and
 0 to 50 parts by weight of a plasticizer.
6. The composite mat of Claim 4, wherein the base layer and the cap layer each comprise:
- 15 100 parts by weight nitrile rubber;
 50 to 100 parts by weight of filler material;
 1 to 2 parts by weight of a cross-linking agent;
 1 to 4 parts by weight of an activator;
 0.1 to 3 parts by weight of an accelerator;
20 1 to 2 parts by weight of an antioxidant;
 1 to 2 parts by weight of an antiozonant; and
 10 to 25 parts by weight of a plasticizer.
- 25 7. The composite mat of Claim 3, wherein the colorant comprises an organic dye or pigment.
8. The composite mat of Claim 7, wherein the colorant comprises an inorganic pigment.
- 30 9. The composite mat of Claim 1, wherein the base layer has a first thickness and the cap layer has a second thickness, wherein the first thickness is greater than the second thickness.
- 35 10. The composite mat of Claim 1, wherein the composite sheet has a second plurality of cleats on a lower surface of the composite mat.

11. The composite mat of Claim 1, wherein the cap layer comprises one or more juxtapositioned discontinuous layer portions.
12. The composite mat of Claim 1, wherein the mat is made by a method comprising:
forming the base layer;
forming the cap layer;
calendering the base layer together with the cap layer to form a composite sheet free from air or other voids between the base layer and the cap layer;
molding the composite sheet to form a molded composite sheet; and
curing the molded composite sheet under heat and pressure.
13. The composite sheet of Claim 12, wherein the cap layer is at least partially cured prior to forming the composite sheet.
14. The composite sheet of Claim 12, wherein the cap layer is formulated to cure at a faster rate than the base layer.
15. A method of making a composite mat comprising:
forming a base layer from a first polymeric material;
forming a cap layer from a second polymeric material;
forming a composite sheet from the base layer and the cap layer; and
shaping the composite sheet under heat and pressure to form a three-dimensionally molded composite mat.
16. The method of Claim 15, wherein the cap layer is at least partially cured prior to forming the composite sheet.
17. The method of Claim 15, wherein the cap layer is formulated to cure at a faster rate than the base layer.

18. The method of Claim 15, wherein the base layer and the cap layer are formed by separate calendering steps.

5 19. The method of Claim 15, wherein the base layer has a first thickness, and the cap layer has a second thickness; wherein the first thickness is greater than the second thickness.

10 20. The method of Claim 19, wherein the first thickness is substantially the same throughout the base layer and is within the range of about 1.5 millimeters to 5.0 millimeters, and the second thickness is substantially the same throughout the cap layer and is within the range of about 0.5 millimeters to 1.0
15 millimeters.

21. A composite floor mat having a lower surface and a first plurality of cleats on an upper surface; wherein the composite mat comprises:
20 a base sheet formed from a first polymeric material and having a first thickness; and
a cap layer formed from a second polymeric material and having a second thickness; wherein the cap layer further comprises a colorant such that the cap layer is visually
25 distinguishable from the base layer.

22. The composite mat of Claim 21, wherein the second thickness is less than 2.0 millimeters.

30 23. The composite mat of Claim 21, wherein the base layer is free from additional colorants and has a natural black color.

35 24. The composite mat of Claim 21, wherein the composite mat has a second plurality of cleats on the lower surface.

25. The composite mat of Claim 21, wherein the composite mat has land areas comprising the first polymeric material and the second polymeric material, the land areas being present between adjacent cleats.

5

26. The composite mat of Claim 21, further comprising a border around a periphery of the mat, the border having an inner edge and an outer edge; wherein the border has a height at the inner edge substantially equal to the height of the first plurality of cleats and a height at the outer edge less than the inner edge height.

10

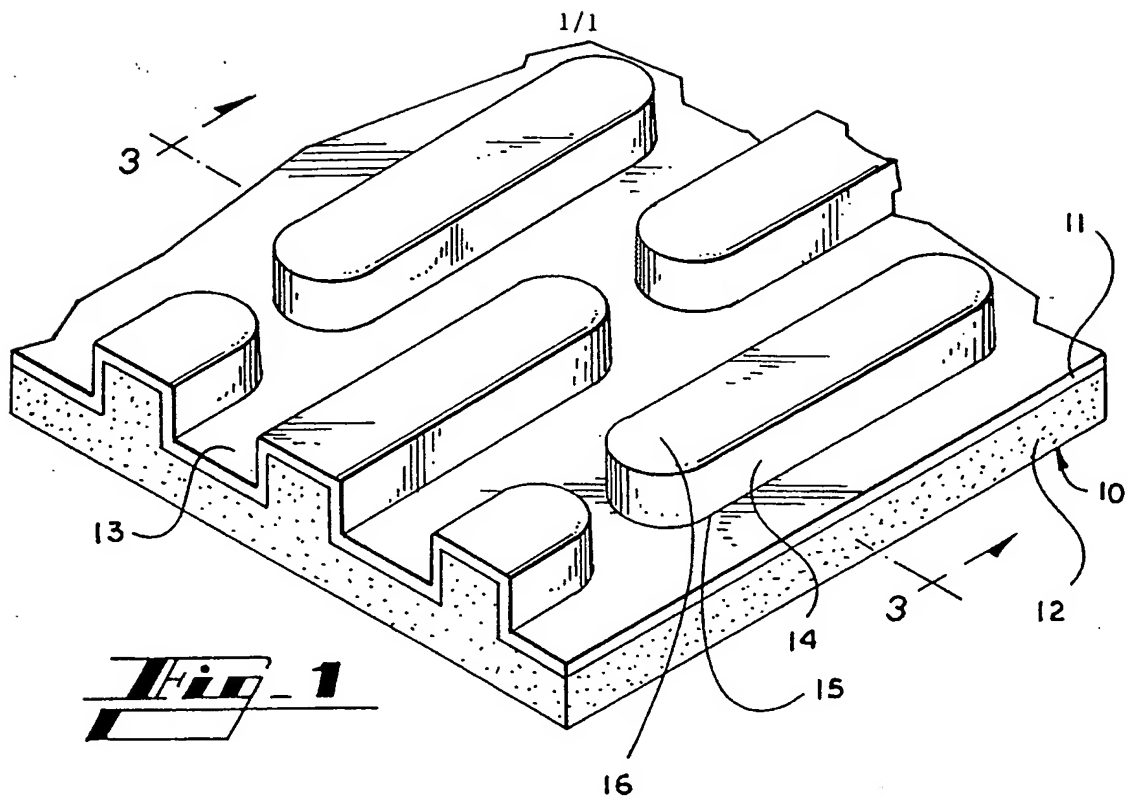


Fig. 1

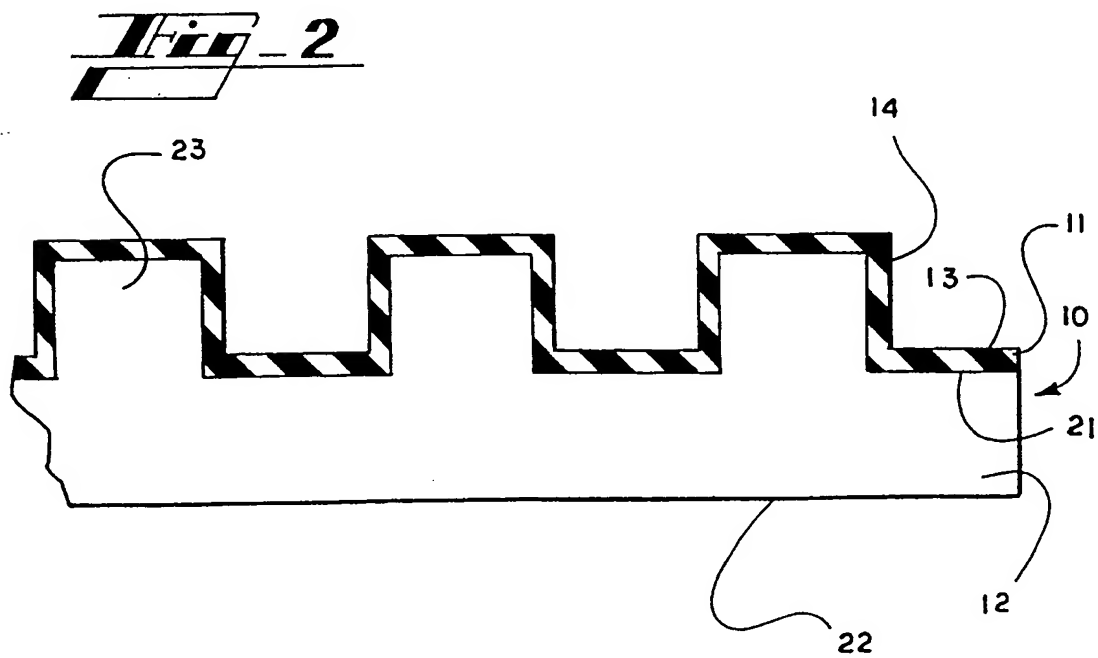


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/23050

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :A47G 9/06; B28B 5/00; B32B 3/00 US CL :Please See Extra Sheet. According to International Patent Classification (IPC) or to both national classification and IPC																				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 5/417; 264/167,171.1,171.25,173.1,175,241,245; 428/83,143,161,172,192,207,493 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched NONE Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) NONE																				
C. DOCUMENTS CONSIDERED TO BE RELEVANT																				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																		
Y	US 3,669,828 A (USAMOTO ET AL) 13 June 1972, see column 2, lines 10-53.	1-26																		
Y	US 5,362,544 A (REUBEN) 08 November 1994, see column 2, lines 5-24 and column 3, lines 53-69.	1-26																		
Y,P	US 5,891,546 A (SHERMAN) 06 April 1999, see column 3, lines 10-24.	1-26																		
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.																				
<table border="0"> <tr> <td colspan="2">* Special categories of cited documents:</td> <td>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>*A* document defining the general state of the art which is not considered to be of particular relevance</td> <td>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> <td></td> </tr> <tr> <td>*B* earlier document published on or after the international filing date</td> <td>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> <td></td> </tr> <tr> <td>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>*A* document member of the same patent family</td> <td></td> </tr> <tr> <td>*O* document referring to an oral disclosure, use, exhibition or other means</td> <td></td> <td></td> </tr> <tr> <td>*P* document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			* Special categories of cited documents:		*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone		*B* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art		*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family		*O* document referring to an oral disclosure, use, exhibition or other means			*P* document published prior to the international filing date but later than the priority date claimed		
* Special categories of cited documents:		*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention																		
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone																			
B earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art																			
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family																			
O document referring to an oral disclosure, use, exhibition or other means																				
P document published prior to the international filing date but later than the priority date claimed																				
Date of the actual completion of the international search 22 DECEMBER 1999		Date of mailing of the international search report 18 JAN 2000																		
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer DONALD J. LONEY <i>Donald J. Loney</i> Telephone No. (703) 308-0661																		

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/23050

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

5/417; 264/167,171.1,171.25,173.1,175,241,245; 428/83,143,161,172,192,207,493